

author: **Antonino Di Raimo**

organization: Ph.D. candidate, Dipartimento di Architettura e Progetto, Università 'La Sapienza', Roma

country: Italy

Architecture as Caregiver: Human Body - Information - Cognition

abstract: Recent studies in contemporary architecture have developed a variety of parameters regarding the information paradigm which have consequently brought different results and techniques to the process of architectural design. Thus, the emergence of an ecological thinking environment and its involvement in scientific matters has determined links moving beyond the conventional references that rely on information. It is characterized as an *interconnected and dynamic interaction*, concerning both a theoretical background and providing, at the same time, appropriate means in the architectural design process (*Saggio, 2007, 117*). The study is based on the assumption that Information Theory leads into a *bidirectional* model which is based on interaction. According to it, I want to emphasize the presence of the human body in both the architectural creation process and the use of architectural space. The aim of my study, is consequently an evaluation of how this *corporeal view* related to the human body, can be organized and interlinked in the process of architectural design. My hypothesis relies on the interactive process between the information paradigm and the ecological one. The integration of this corporeal view influences the whole process of architectural design, improving abilities and knowledge (Figure 1).



Figure 1.
Human corporeity between
the two paradigms.

I like to refer to this as a *missing ring*, as it occurs within a circular vital system with all its elements closely linked to each other and in particular, emphasizes architecture as a living being.



1 The human body and the designer

J. Pallasmaa promotes the importance of the human body within an architectural setting. His work about architecture and senses puts the human body at the centre, considering the user and the designer in the same vital space. The relevance of the body in the architectural process finds its base in the Cartesian model and its concept of the body perceived as the *eye of the mind*. Pallasmaa's theory instead focuses more on a cultural dimension, involving the importance of the existence as such. In fact, he discusses the lack of appropriate technological tools that do not give a correct architectural image. This results in the impossibility of an exact corporeal view, it stays *flat* as he puts it (Pallasmaa, 2005, 12). It should not be overlooked, however, that already in the 1950s the information paradigm was discussed and emphasis was put on the central role of the body as a *living system*. In the framework of studies and comparison of electronic and mechanical systems related to biological systems (cybernetic), an appropriate informative model/theory was developed in order to properly define the exchange between living and artificial systems (Wiener, 1968). Initially, the *computer-mind/brain* was the priority frame to work on (Piattelli Palmarini, 2008). This successively led to the exploration of the field of cognitive sciences (Figure 2).

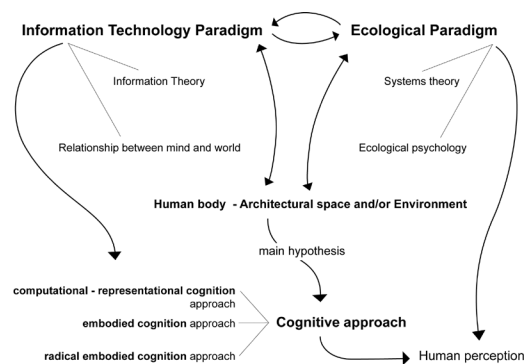


Figure 2. Concept Map 1.

My personal contribution focuses on the following elements:

- How recent studies have re-evaluated the body experience within a cognitive and perceptive dimension. These studies are the *embodied cognitive science* and the *radical embodied cognitive science* (Varela, Thompson, & Rosch, 1991; Chemero, 2009).

- How to consider the implications of the body's role in a homogeneous design process within a contemporary cognitive approach, likely to be rooted in both the information paradigm and the ecological one.

Evident are the characteristics concerning both these aspects, as *relational* perspectives. The aim of this research is to develop my projects and design techniques within a corporeal dimension, choosing a computer data processing approach instead of an existential one. My decision follows from my participation in the Feidad competition, and the editing of the Flux Generation project. My contribution consisted in the design of a building using software. I intuitively realized that according to the type of building I was supposed to plan, instead of CAD, I needed a virtual corporeal model. As a matter of fact, the building's architectural space, with a functional fruition mainly aimed at having appropriate dancing spaces, is built using trajectories left by a virtual dancer. This experiment was developed in the following steps: I created seven *virtual dancers*, one for each dancing step and animated them (Figure 3).

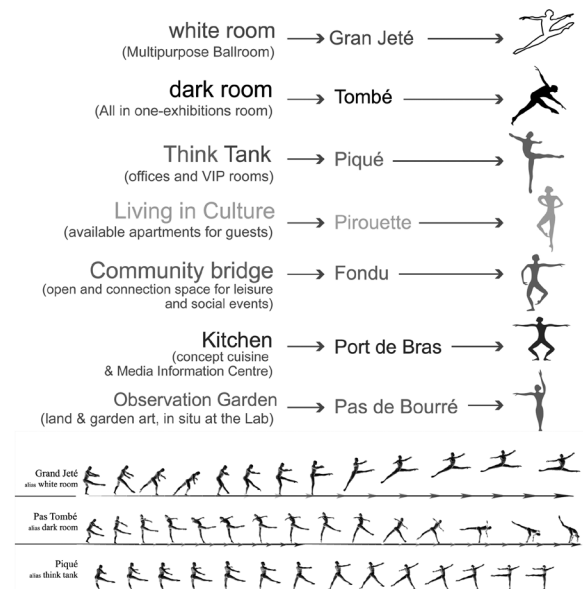


Figure 3. Building spaces, dance steps and frames of animation.

For each dancer I identified specific hot points, more specifically the eyes, the feet, the hands, and the pelvis (Figure 4).

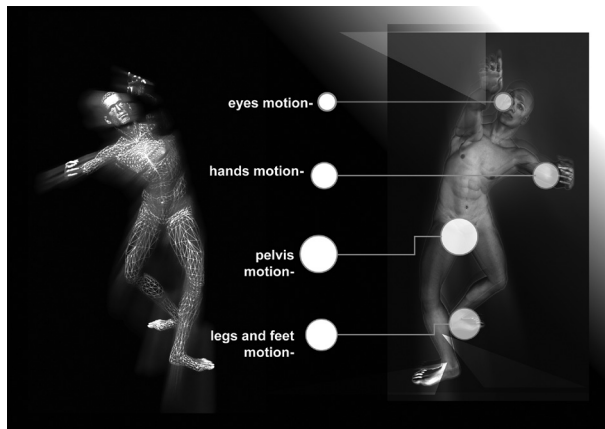


Figure 4. The virtual dancer with the hot body points.

These hot points were used to trace the spatial temporal trajectories of each dancer during the animation (Figure 5).

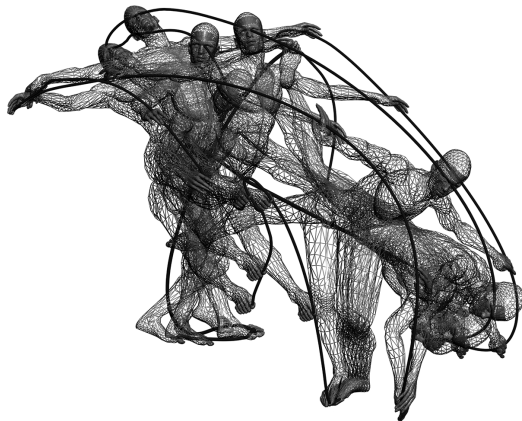


Figure 5. Pas Tombé Trajectories.

Finally, on the trajectories obtained I created three-dimensional stripes that are supposed to frame the building-base (Figure 6).

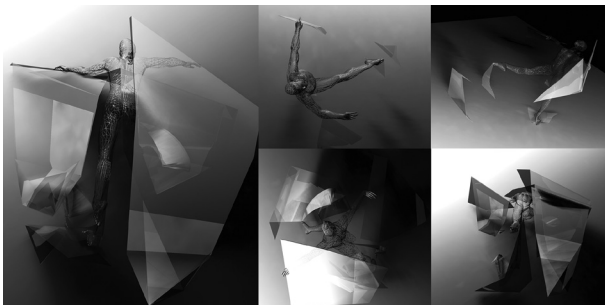


Figure 6. Pas Tombé: three-dimensional stripes on the trajectories.

During my first year of my Ph.D. education, I consolidated the need of using an *embodied agent* and not a mere geometric entity as a generating project element. Having been a professional dancer myself, my attempt consisted of a screen projection of my body, endowing the dancing abilities with cognitive elements, as the Flux project requested. A deeper look at The Flux Generation project illustrates other important factors closely linked to the animation techniques developed for video games that consequently led to a more advanced stage, like that of the *Avatar* concept. The term *Avatar*, originating from the Hindu tradition in the technical world refers to a sort of on-line nickname. Furthermore, the term *Avatar* is used in the robotic field referring to *telepresence* applications. The physical body is controlled at a certain distance, forming a sort of bridge between the user's body and a space that otherwise would not be not accessible. Movements refer to the multitude of the body movements. In the Flux Generation, the *Avatar* is a modifiable mesh of human morphology animated by a bone system. Animations are created through multiple key frames. In my opinion, the *Avatar*, a human body model based on the Cartesian three dimensional space, is the response to the architectural culture conceived in the information paradigm. On the other hand, the modernists rely merely on an impersonal and mechanical silhouette and therefore only dispose a limited two dimensional view. Following the above described path, the Flux Generation project clearly constitutes an initial scientific evaluation of the body as a *generative system* in the whole. Its solution could not merely be geometric. This would have resulted in a simple formalization of an ergonomic system. I was dealing with a more complex level. As mentioned before, I believe that contemporary sciences and cognitive sciences have the ability to plan appropriate models highlighting corporeity within an information and ecologic paradigm. Hence, in this interdisciplinary approach, within a theoretical framework, I have chosen to define or call my *Avatar* the *anthropomorphic cognitive agent* (Figure 7).

The *anthropomorphic* side permits work with a humanoid and animated form and an architectonic feedback that considers the relation between space and body. The *cognitive* factors relate to the captured motion, revealing the invisible flow of movements. The trajectory patterns mainly have a cognitive structure and are represented graphically in a second instance (Nicoletti & Rumiati, 2008). They refer to abilities such as memory, body intelligence, and the moving collocation in a certain space (Figure 8).

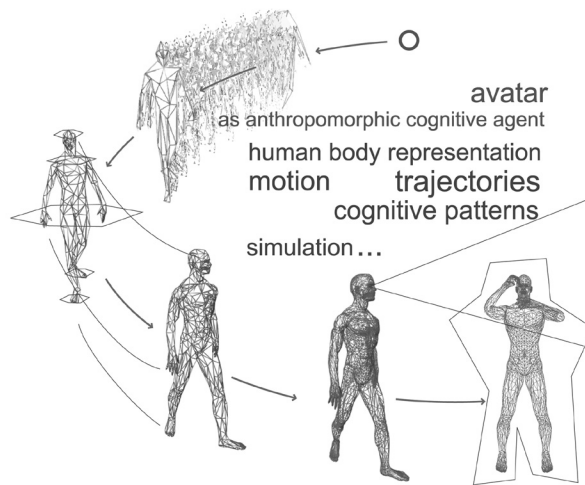


Figure 7. Avatar as anthropomorphic cognitive agent.

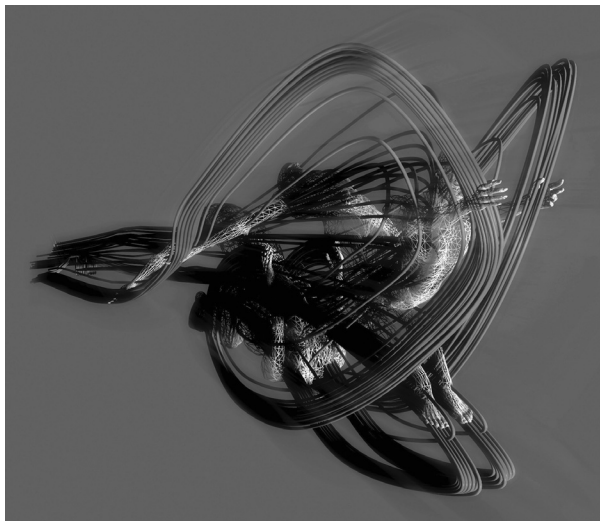


Figure 8. Diving: cognitive structure of the trajectories.

The *agent* factor is used to simulate interactions with a determined environment. Therefore, relying on the *embodied* traditional aspect in cognitive sciences, I am referring to the body and space as an *enaction*. In other words, *perception consists in a perceptually guided action and cognitive structures emerge from the recurrent sensor patterns that enable actions to be perceptually guided* (Varela, Thompson & Rosch, 1991, 173). This is the hypothesis for the project I am still developing. It needs to be further developed on the *body-environment* relation and interaction. Furthermore, the development of cognitive patterns issued by mathematical formulas based on dynamic systems, is required. These patterns are coherent with Chemero's

interpretation of the *affordances* (Chemero, 2009). If my assumption of the body as a cognitive system is the basis of my work, an additional fundamental consequence needs to be explained. In fact, an overall comprehension of *corporeity* is in its biological nature, or better, in its *being alive*.

2 Human body as living system

The second part of my paper will discuss the following points:

- The cognitive activity of the body system and its space perception has a biological basis
- The body as a biological system has a *living, generative* nature

The design process activity considers the cognitive and body activity closely interlinked. Consequently, the basis of an IT design methodology needs to look at the human body as a living body, referring to a two-dimensional level:

- A *heteronomous* system, an open system with an interconnecting logical relation between its own components and external ones
- An *autonomous* system with own autonomy with opening and closing models. In this case we can call combination the relation between the body and its environment intended as a *coupling* (Maturana & Varela, 1985; Chemero, 2009).

The first perspective has resources in the psychological field. The aspects of the behaviorist approach were soon overlapped by cognitive ones in the 1950s, and successively developed into neuroscience studies. Recent research has fully outlined the interrelationship between the brain (biological base), its sub-systems, and environmental stimulus. The Skin—Building project has its bases on a heteronomous assumption that considers a skin concept perspective and repropose an architectural modular one for buildings with blind facades. The skin equipped with mini-organs acts as a cognitive network on different levels: the producing of energy, noise level control and the plant production (figure 9).

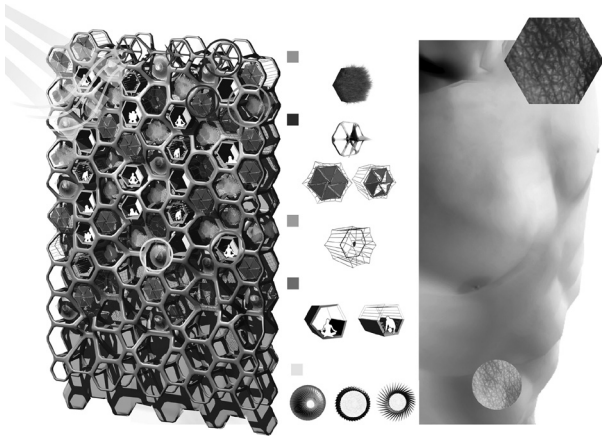


Figure 9. Skin – Building project. Phd Seminar
'Blind Walls' - Prof. O. Carpenzano.

It is of interest to identify the patterns that relate external information to the body's internal mapping, be it in a biological or a cognitive sense. However the existence of an internal representation of the information at a mental level (traditional cognitive sciences hypothesis), or the exclusive dependence of the cognition of an embodiment without referring to an internal representation (radical embodied cognitive hypothesis), has only a relative importance, since their simultaneous availability is the most important feature. Furthermore, the fundamental importance of the possibility to analyze the body as an *input - output* system has to be stressed. This may allow the designer to model and describe the interaction between body and space, aiming to obtain an interactive digital model organized by a corporeal unit and an environmental system. The second point to discuss, regards the human body as a living system although an autonomous and closed entity. Maturana's states that: *living systems are units of interactions. Living systems are cognitive systems, and living as a process is a process of cognition*. The focus is on the cognitive aspect considered at the same level of the living one, or better, is *identical*. Furthermore, *the nervous system expands the cognitive domain of the living system by making possible interactions with 'pure relations'; it does not create cognition* (Maturana, 1985, 59). This distinction clearly shows how our description of the environment, based on an internal and external mapping, is the result of our own linguistic cognitive domain and not based on an objective realistic perspective. Maturana and his successor, Varela successively developed a rigorous frame of the living reality, inventing the term of autopoiesis from Greek, *poiesis*, which means a production of oneself. *An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction)*

of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network (Maturana & Varela, 1985, 131). Taking into consideration the living perspective as an organization, and with that, withdrawing from a historical and theological meaning, the autopoiesis can be sufficiently considered as a classifying element. This means that although a living system is described as a closed process, when an external factor is important, it can be referred to as a structural coupling. Whenever the conduct of two or more unities is such that there is a domain in which the conduct of each one is a function of the conduct of the others, it is said that they are coupled in that domain (Maturana & Varela, 1985, 166). The nature of these coupling living systems is determined by an autopoietic organization, which generates a higher autopoietic level system. Attention has to be brought to the question because of the co-presence of the cognitive aspect and the autopoietic phenomenon; the architectural design could result in the creation of an architecture building that may be called *alive*. As a consequence of this thesis, the evidence the *co-living* system in architecture has, with its own autopoietic units (the living and projecting corporeity levels), continuously defers towards opening phases with an own autopoietic human body organization. The initial idea for a future development can be considered in a body – architecture structural coupling which may be a source inherent an effective materialization on a molecular level. At the same time, viewing the *body–architecture structural coupling* as a heteronomous system, the variety of currently manipulative information issues would be able to select different corporeity sub-systems in order to form cognitive module designing devices. As autonomous systems, the multiplicity of these aspects can be collected and organized according to an autopoietic categorization (Figure 10).

3 Ecology and Information: Architecture as a living caregiver

As mentioned before, a central overall aspect is the development of an appropriate data processing model. A model based on human body should be understood as an axiomatic institution. It can represent a model through a three level environment and based on the designer's corporeity, constitutes the interactive mean between

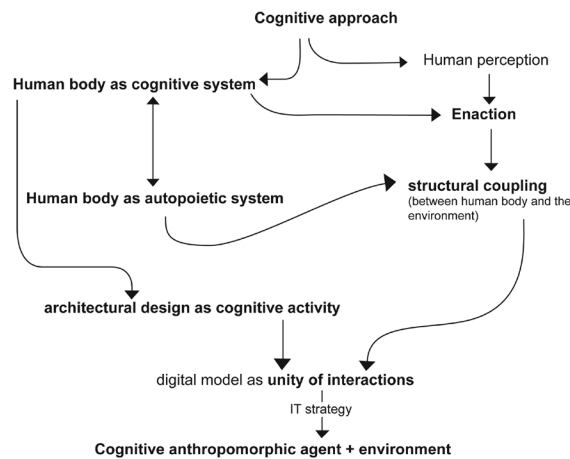


Figure 10. Concept Map 2.

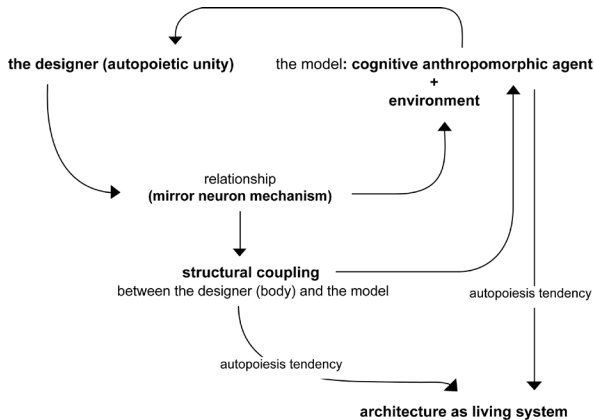


Figure 11. Concept Map 3.

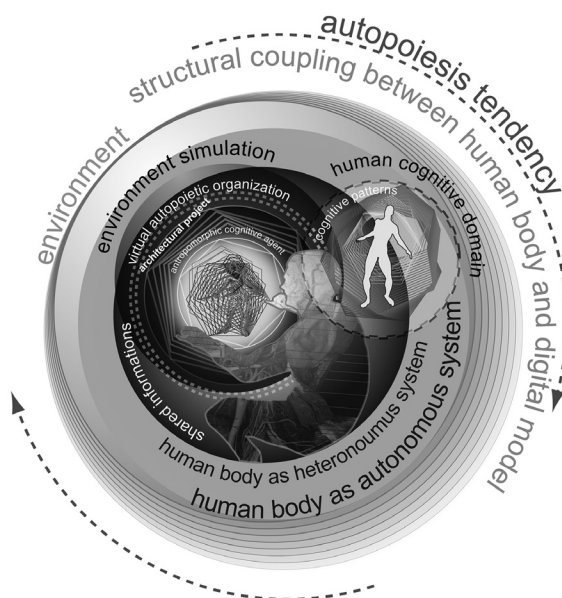


Figure 12. Diagram of structural coupling between human body and digital model.

designer and the architectural model on the screen. The concept of body unit and environment, at this stage, as a unique and coupled system must be clear. Fundamental is the presence of both the anthropomorphic cognitive agent and the one implied in the structural coupling process. These can be referred to as sub-systems which can change environment characteristics forming various interactive architectural elements, forming a building envelope for the body. Regarding the interaction phenomenon between the anthropomorphic agent and the designer through a screen projection, it is useful to consider some results obtained by neuroscientific studies, particularly the discovery of the so called *mirror neurons* or the neuronal correlation of the essence of the relationship (Rizzolatti and Sinigaglia 2006). As a matter of fact, the mirror system, activated during the execution of determined corporeal gestures, suggest a biological reality for which the relation between body and external reality implies a proper *simulation system*, during simple observations (Piattelli Palmarini, 2008, 201). Neuroscientists have also highlighted that these neuronal patterns activate themselves even when someone is observing a representation of a virtual human body performing some actions (Oliverio, 2008, 77). Albeit Pallasmaa's ideas, an anthropomorphic agent within an IT project planning methodology, is indeed useful as it enables control over the variety of cognitive aspects. Its communicative interaction, in fact, involves a common informational pattern between the subjects (Figure 11).

The evolution of these controlling systems, such as those aimed for video games consoles and with a significant screen interaction, will allow architects in the future to achieve and go far beyond contemporary technical computer tools such as the simple keyboard or mouse. If the above devices involve the body as an heteronomous system, *autopoiesis* could be the main referent phenomenon that organizes the building's cognitive patterns. This structural coupling of body and architecture should be evident at the beginning of the architectural design process (Figure 12).

The architectural result would have a cognitive body network with *autopoiesis tendency*, and according to Maturana and Varela's viewing, specifically move to developing a living *being phenomenon*. We can find some elements of this study in F. Roche, R&S and Z. Oksiuta researches. In fact, the architectural projects obtained by evidencing human corporeity, could be characterized by words, such as *mirroring*, *projection*, *identification*, etc. These terms belong to the psycho analytical vocabulary

and have, in recent years, gained more relevance, due to their explanation of the mirror neurons, as discussed before (Gallese, Migone, & Eagle, 2006). A living being in architecture would, thus, mean having also an *affective* dimension. This architectural bi dimensional direction can foresee itself as a result as intelligent *caregiver*. Not only would it be an element taking care of human life beyond being perceived as shelter, but it would be fundamental in enriching the variety of humanity or I might say, raising it to a higher level.

4 Conclusions

The research presented inevitably brings about the exploration of new directions and relations with other fields. Interacting or simply relating is one of the strongest aspects in a heteronomous living being system that inevitably implies embodiment processes; at the same time, an autopoietic issue can just turn out to be a further contribution to enriching the diversity in the world.

Acknowledgements

A special thank to my advisor Prof. Antonino Saggio for his continuous support in the Ph.D program. He is always there to give advice and talk about my ideas. I also thank Mme Cynthia Odier, Director of Flux Laboratory—Geneva, for helping me in my research.

References

- Chemero, A. (2009). *Radical embodied cognitive science*. Cambridge, MA: MIT Press.
- Gallese, V., Migone P., & Eagle, M.N. (2006). *La simulazione incarnata: i neuroni specchio, le basi neurofisiologiche dell'intersoggettività e alcune implicazioni per la psicoanalisi*. In *Psicoterapia e scienze umane*. XL, 3: 543–580.
- Maturana, H. R. & Varela, F. (1985). *Autopoiesi e cognizione La realizzazione del vivente*. Venezia: Marsilio.
- Nicoletti, R. & Rumiati, R. (2006). *I processi cognitivi*. Bologna: Il Mulino.
- Oliverio, A. (2008). *Prima Lezione di Neuroscienze*. Roma; Bari:Laterza.
- Pallasmaa, J. (2005). *The eyes of the skin architecture and the senses*. London: Academy Editions.
- Piattelli Palmarini, M. (2008). *Le scienze cognitive classiche: un panorama*. Torino: Einaudi.
- Rizzolatti, G., & Sinigaglia, C. (2006). *So quel che fai – Il cervello che agisce e i neuroni specchio*. Milano: Raffaello Cortina Editore.
- Saggio, A. (2007). *Introduzione alla rivoluzione informatica in architettura*. Roma: Carocci.
- Varela, F. J., Thompson, E. & Rosch, E. (1991). *The embodied mind. Cognitive science and human experience*. Cambridge, MA: MIT Press.
- Wiener, N. (1968). *Introduzione alla cibernetica*. Torino: Universale Bollati Boringhieri.

Appendix

Corporeal. I use the term corporeal to emphasize that both the designer and the user have a physical, material body. In fact, their minds are embodied. In cognitive sciences the term embodied highlights that *cognition depends upon the kinds of experience that come from having a body with sensorimotor capacities, and that these sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context* (Varela, Thompson and Rosch 1991, 172-173).

Relation and Affordances. Chemero re-formulates Gibson's concept of Affordances. He defines them Affordances 2.0. He claims that Affordances are not just *relations between abilities to perceive and act and features the environment* but they also *causally interact in real time and are causally dependent on one another* (Chemero 2009, 150-151). In my opinion, they are *interacting relations or interconnected and dynamic interactions*.